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DL40-1A

INSTRUMENT DIVISION

DUAL LAB SERIES POWER SUPPLY

DOCUMENT NO. 120012-01

OPERATING AND SERVICE MANUAL

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CHAPTER 1

DESCRIPTION

1.1 INTRODUCTION

The DL40-1A Power Supply is a flexible and dependable source of DC power, which can be used to meet a variety of needs. These needs may range in scope from inspection and production testing, to laboratory bench testing and systems applications.

The wide range of outputs available makes this unit well suited for use as basic laboratory power sources. The ability to provide power packaged in minimum space with high reliability meets the demands of most systems requirements.

The versatility of this unit is enhanced by the enclosure of two identical but independently adjustable power supplies in a common package.

All components used in the construction of this unit is of the highest quality available. Each electrolytic filter capacitor is of computer grade, and has been quoted by the manufacturer as having a life expectancy exceeding ten years.

This instruction manual provides general characteristics and specifications, operating procedures, theory of operation, maintenance and troubleshooting, calibration, parts list and related schematics for the DL40-1A Power Supply.

1.2 DESCRIPTION

The DL40-1A Silicon Dual Lab Power Supply is a dual-output, dual-range unit designed for general laboratory applications. It consists of two separate internal power generating sections, each adjustable in voltage and with separate outputs on the Front Panel and Rear Panel barrier strip.

A variety of voltage and current outputs are available providing unexcelled operational versatility and flexibility. This output flexibility permits the user to have complete convenience in filling laboratory power supply requirements.

The Dual Lab Power Supply utilizes silicon semiconductors permitting operation at its maximum temperautre rating without derating.

1.3 GENERAL FEATURES

Remote sensing, remote voltage programming, calibrated adjustable current limiting, 10-turn voltage adjustment controls, independently adjustable dual outputs, no turn on/turn off transients and series or parallel operation are featured in the Model DL40-1A. Output, Sensing and REmote Programming terminals are located on a thirteen-terminal barrier strip mounted on the Rear Panel of the unit. The AC Power Switch, AC Pilot Lamp, 10-turn voltage controls, current limiting control and appropriate metering devices are all located on the Front Panel. For convenience, additional output terminals have been provided on the Front Panel.

1.3.1 Constant Voltage Mode

A constant voltage is maintained across the output terminals within the rated voltage output, provided that the load does not draw more than the rated output current.

1.3.2 Short Circuit Protection

Short circuit protection is provided by the Automatic Current Limiting circuit which limits the maximum output current under all load conditions. In the event of a short circuit, the output voltage will return to its previous level only unpon removal of the short circuit.

The point at which current limiting occurs is adjustable by the Front Panel Current Limit Control.

1.3.3 Remote Programming

Remote Programming is provided in the voltage mode of operation, and may be utilized over the entire voltage range of the unit. The scale factor for Remote Voltage Programming is 500 ohms per volt.

1.4 PRECAUTIONARY MEASURES

1.4.1 Wire Size

To assure proper regulation under all load conditions, and to prevent severe distortions of the AC

line voltage, it is very important to take into consideration the physical size and current handling capabilities of the input power line. Serious losses in regulation and increase in ripple may result from underrated or overloaded AC input lines. The maximum AC impedance from the breaker box to the Power Supply input should not exceed 0.75 ohms.

1.4.2 Voltage Regulator and Inverter Inputs

Care should be used when using voltage regulators or inverters as a primary power source. The outputs of these devices are usually not sinusoidal in nature, and if used as the AC source for the Power Supply, may cause serious loss of regulation of the Power Supply output. Capacitive input filtering used for semiconductor power supplies requires charging to the peak of the rectifier AC wave which non-sinusoidal AC sources may not provide.

1.4.3 System Considerations

In systems applications it is recommended that each Power Supply input power line be run separately to the AC distribution box, in order to minimize cross coupling and interaction between equipment. Do not run sensitive signal leads such as the remote sensing leads in the same cable as the AC input without shielding. To keep the AC ripple in the output to a minimum it is recommended that the AC input cables should not be run in close proximity to the output load cables.

1.4.4 Terminal Post Resistance

All terminals and shorting links serving Outputs, Sensing and Programming must be securely tightened before use. Serious loss of regulation and an increase in ripple can result due to a voltage drop caused by loose terminals and shorting links.

The specifications cited herein for regulation and ripple can be readily attained on every power supply providing the proper method of measurement is employed. The major consideration is that the highly stable meter and oscilloscope, specified in the calibration procedures, must be connected to the sensing terminals and not the load terminals. The reason for this precaution is that the voltage drop between the load terminals and sensing terminals will yield an inaccurate regulation ripple measurement.

1.5 SPECIFICATIONS

Table 1-1 is a complete list of standard specifications for the Model DL40-1A.

TABLE 1-1 SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Input:	100-125/200-250 VAC, 47-420 Hz. (Internal tap change)
Output:	Dual, floating; isolated from ground 300 VDC maximum.

Volts	Amps	Impedance
Dual 0 to 40	0 to 1	0.002Ω (Nominal, DC-1 kHz)
0 to 40	0 to 2 (parallel)	
0 to 80	0 to 1 (series)	

Regulation Line:	0.01% or 2 mV*, for 100-125/200-250 VAC line change at any output within specifications.
Regulation, Load:	0.01% or 3 mV*, no load to full load, at any output within specifications.
Ripple:	250 μV RMS, 2 mV p-p (10 MHz) (20 mV p-p @420 Hz input).
Stability:	0.05% or 10 mV*, for 8-hours after warmup. Measured at constant line voltage, load and ambient temperature.
Temperature Coefficient:	(0.2% +400 μV)/°C.
Temperature Range:	0 to +50°C.
Recovery Time:	25 μs to within 0.05% of 15 mV* of output voltage, for 100% step change in rated load.
Short Circuit Protection:	Automatic Calibrated Current Limiting.
AC Power Input Protection:	Fuse.
Remote Voltage Programming:	Over output voltage range. Scale factor approximately 500 ohms/volt.
Remote Sensing:	Maintaines rated regulation directly at the load. Maximum line drop 0.5 volts per leg.

TABLE 1-1 SPECIFICATIONS (Cont'd)

ELECTRICAL SPECIFICATIONS (Cont'd)

Voltage Adjustment Range:	Continuously adjustabel, 10-turn voltage control.

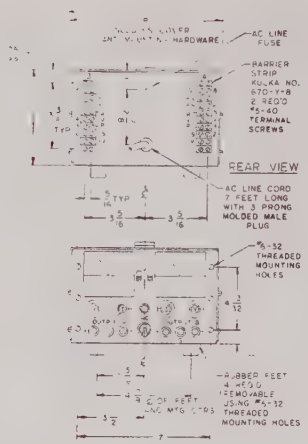
GENERAL & PHYSICAL SPECIFICATIONS

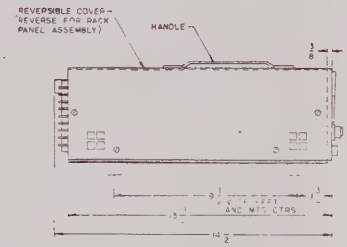
Design Principle:	Precision Seris Pass Regulation.
Operational Mode:	Constant Voltage with automatic adjustable current limiting.
Controls	
Voltage:	10-turn control.
Current Limit:	Front Panel calibrated control, 0 - 1A.
Input Power:	Front Panel switch and indicator, AC ON.
Metering:	Combination Volt/Ammeter with Front Panel selector switch for each supply.
Terminals	
Front Panel:	Positive Output (+V); Negative Output (-V); and Ground (G), for each supply.
Rear Panel:	Output B Terminals 1-5. Output A Terminals 8-12.

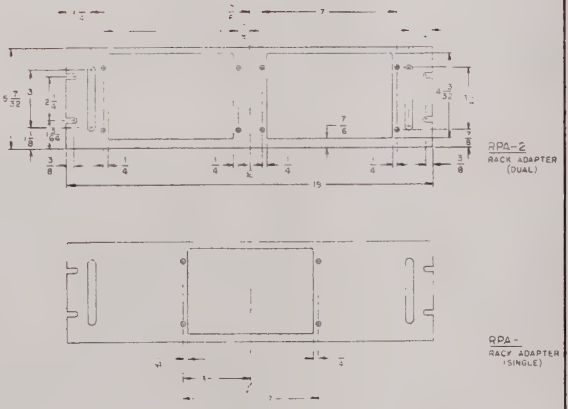
(1) Negative Output -V,
(2) Negative Sensing -S,
(3) Remote Voltage Programming RVP,
(4) Positive Sensing +S,
(5) Positive Output +V,
(6) Spare.
(7) Ground GND,
(8) Negative Output -V,
(9) Negative Sensing -S,
(10) Remote Voltage Programming RVP,
(11) Positive Sensing +S,
(12) Positive Output +V,
(13) Spare.

Rack Mounting:	RPA-1 (single) RPA-2 (Mounts two DL40-1A units).
Size:	7-3/4" W x 4-15/16" H x 14-1/2" D.
Weight:	17 lbs.

*Whichever is greater


AC LINE FUSE
BARRIER STRIP KULKA NO. 670-Y-8 2 REQ'D #5-40 TERMINAL SCREWS
REAR VIEW
AC LINE CORD 7 FEET LONG WITH 3 PRONG MOLDED MALE PLUG
#5-32 THREADED MOUNTING HOLES
RUBBER FEET 4 REQ'D REMOVABLE USING #5-32 THREADED MOUNTING HOLES





For Rack Mounting: use RPA-1 or RPA-2

CHAPTER 2

INSTALLATION AND OPERATION

2.1 MECHANICAL INSTALLATION

2.1.1 General

If the DL40-1A Power Supply is to be used in a portable bench type configuration, no special mechanical installation is required. However, if the unit is to be rack mounted, special rack mounting adapters must be used to secure the unit to the relay racks. Single (RTL-1) and dual (RTL-2) rack panel adapters are available.

2.1.2 RTL Rack Panel Adapter Mounting

A carrying handle is provided on the DL40-1A for ease of handling for normal bench use. When the power supply is to be mounted into the RTL rack adapter the handle must be removed for top clearance.

Covers are available without handles from the factory, and can be obtained free of charge with an exchange for the cover with handle, or if the radk adapter is ordered at the same time as the Power Supply a cover without handle will be normally provided.

To mount the DL40-1A into the rack adapter:

1. Remove the 4 rubber feet by unscrewing the holding screws. Captive nuts remain on bottom of case. Discard removed hardware.

2. Place the Power Supply on chassis with the front through the opening provided.

3. Turn rack adapter on its side and secure unit to rack using hardware supplied,

    4 #10-32 x 3/8 L Pan
    4 #10 Flat Washers
    4 #10 Lock Washers

2.2 ELECTRICAL CONNECTIONS

2.2.1 Input Power

A heavy duty 3 wire line cord and molded plug with with grounding prong provides a path for input power to the unit.

The power handling ability of the AC power lines feeding AC power to the line cord must be considered, as serious losses in regulation and substantial increases in ripple can occur as a result of insufficient power handling capacity of these lines. The AC impedance from the breaker box to the Power Supply input connector should not exceed 0.75Ω. All AC power line connections must be securely tightened, and any movable electric contact surface (such as the wiper arm of a variable transformer) should be kept clear of impedance producing oxide coatings.

Care should be exercised in selecting the proper wire size for the AC input lines. The figures listed in Table 2-1 will serve as a guide in making this selection.

The input transformer of the DL40-1A is provided with taps so that the unit may be used with either 115 VAC or 220 VAC, 47-420 Hz inputs.

Units are generally set up for standard 115 VAC. To change for 220 VAC operation the following p procedure is to be followed.

1. Remove the Power Supply Cover.

2. Disconnect black jumper wires between terminals 1 and 15, and 2 and 16 of main power transformer Tl.

3. Connect terminals 2 and 15 together using both jumper wires removed in 1. above so they will be available for conversion back to 115 VA VAC input if required in future use.

It is advisable to tag the power cord when the input taps are changed to prevent useage on incorrect AC power lines.

TABLE 2-1 AC INPUT WIRE SIZE

Length of Run (Single Lead)	Wire Size AWG Standards
20 feet or less	16
20 feet to 50 feet	14

2.2.2 Rear Panel Output

A 13 position terminal barrier strip, mounted on the rear panel provide independent output, sensing, programming and ground connections for both sections of the unit. Table 2-2 Shorting Link

Application, lists the required shorting link connections for the various modes of operation.

TABLE 2-2 SHORTING LINK APPLICATIONS

Terminals	Condition	Function
1 & 2 4 & 5	Connected	Local sensing and regulation at rear output terminals Output B.
8 & 9 11 & 12	Connected Connected	Local sensing and regulation at rear output terminals Output A.
1 & 2 4 & 5	Not connected Not connected	Remote sensing and regulation at load. Run individual lead wires between terminals 2 & 4 to load (AWG #18) Output B.
8 & 9	Not connected	Remote sensing and regulation at load. Run individual lead wire between terminals 9 & 11 to load (AWG #18) Output A.

NOTE

Front panel output terminals are always connected internally for local sensing and cannot be used for remote sensing.

2.2.3 Front or Rear Panel Output Selection

DC output terminals for both sections of the Power Supply are located on the Front and Rear Panels of the unit. Sensing terminals, however, are available only at the Rear Panel barrier strips.

2.2.4 Rear Panel Shorting Link Application

The Power Supply is shipped from the factory with all shorting links in place across terminals. In this configuration, and with the load connected across the Rear Panel output terminals, local sensing and programming operation from the Rear Panel is provided. Connections for other Rear Panel modes of operation are shown in Table 2-2 Shorting Link Applications.

2.3 FRONT PANEL CONTROLS

The controls and connectors on the Front Panel of the Model DL40-1A are listed in Table 2-3.

TABLE 2-3 FRONT PANEL CONTROLS

Name	Function
AC Power	Toggle switch, controls input power.
Meter Function A Meter Function B	Slide switch, selects output meter indication of either voltage or current.
Voltage Adjust A Voltage Adjust B	Potentiometer, adjust voltage output.
Current limit Adjust control	Potentiometer sets current limit point.

2.3.1 Internal

All internal control settings have been factory preset, and require no additional adjusting. However, if it should become necessary to adjust any of the internal controls due to circuit changes caused by component aging or replacement, refer to the calibration section of this instruction manual.

2.4 OPERATION

2.4.1 Connections

Prior to the application of power, connect all loads, external wiring and shorting links required for the mode of operation desired.

2.4.2 Grounding

Either side of the output may be grounded, or the output may be used in a floating condition

2.4.3 Power On

Connect the line cord to a nominal AC input power source. Set POWER switch S202 to AC-ON and observe that poilot lamp DS101 glows.

2.4.4 Warm-Up

No warm-up time is necessary to place the unit into operation. However, a 30 minute warm-up period is recommended to reach rated stability.

2.4.5 Series Operation

To operate both sections of this Power Supply in a series configuration, connect the output of each section in series. When operating in this mode, it

is necessary to adjust the output of each section independently. The output voltage is equal to the sum of the voltage setting of each section.

2.4.6 Parallel Operation

Both sections of the Dual Lab Power Supply may be placed in parallel to provdie a combined current capability twice that of a single section.

1. Before placing the sections in parallel, each section should be set to provide exactly the required voltage.

2. Set the current limit adjustment on each supply to maximum position if maximum current capability is desired.

3. Connect the Power Supply sections in parallel as shown in Figure 2-1.

WARRING

Two supplies (section) must not be placed in parallel if their voltage outputs are different by more than approximately two volts.

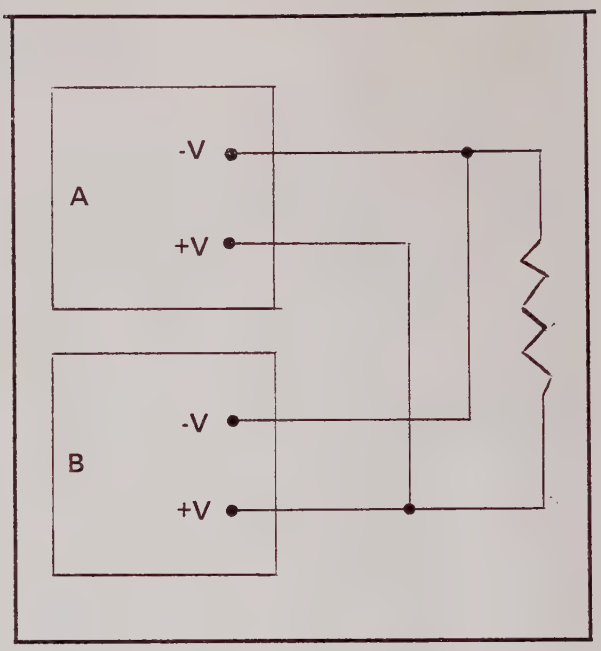


FIGURE 2-1 PARALLEL OPERATION

CHAPTER 3
THEORY OF OPERATION

3.1 GENERAL

The purpose of the Dual Lab Series Power Supply is to provide two fully independent, well regulated and adjustable DC outputs in a single compact and versatile half rack configurations. Both outputs may be used independently or in series or parallel combination with each other, thereby greatly increasing the output range capabilities of the unit.

The electrical circuitry of both operating sections of the unit is identical. To differentiate between the two operating sections, one section is designated as the A Supply and the other as the B Supply. In addition, all reference designations in the B section are prefixed by the number 100. Except for the use of prefix numbers in the B section, the component values for both operating sections are identical. Circuit components which are common have either 100/200 or no prefix at all. In addition, items on heat sink have 200 prefixes.

The reference designations referred to in the following circuit descriptions may be applied to either operating section by adding the prefix number to the reference designation when applicable.

The following paragraphs describe the major circuits used in the DL40-1A Power Supply. As each circuit is described, reference should be made to both the Block Diagram Figure 3-1 and the Schematic Diagram in the rear of this manual.

3.1.1 Primary Input

Input power is obtained through power transformer T1, full wave rectifier sets CR1 & CR2, CR10 through CR13, and filter capacitors C1 & C6.

When AC POWER switch S202 is set to AC ON, pilot lamp DS101 illuminates, and AC power is applied to transformer T1. DC coutput power is immediately available from both operating sections.

3.1.2 Reference Supply

The rectified and filtered voltage from diode rectifiers CR1 and CR2 and filter capacitor C1 is preregulated by reference Zener diode CR3. This stabilized DC voltage is supplied to constant current source Q1, whose output is in turn regulated by voltage reference Zener diode CR5. The voltages developed across voltage reference Zener diodes CR4 and CR5 are highly stable reference voltages established at a higher positive potential than the positive output of the Power Supply.

3.1.3 Series Regulator

The rectified DC voltage from the input diode rectifiers and input capacitor C6 is directed through series pass transistor Q201. Conduction of this transistor is controlled by circuitry which causes it to act as a variable resistor. Overall resistance of the series pass varies in accordance with the need of the Power Supply to increase or decrease its output voltage or current.

Conduction of Q201 is directly controlled by driver stages Q202, Q102 and Q9, which in turn are controlled by error amplifier Q5.

3.1.4 Comparator and Error Amplifier

Voltage sensing and comparison is accomplished by differential amplifier Q7. A sample of the output voltage on the base of Q7 is compared to the stable reference voltage at the base of Q6. An unbalance caused by a change in voltage at either negative sensing (-S) barrier strip terminal 9, or across voltage adjustment control R42, will appear as a voltage change at the collector of Q7.

This difference voltage is amplified by error amplifier Q5, and is used to regulate series pass driver Q202 by means of driver stages Q10 and Q9. Error amplifier Q5 has two diode inputs to its base which form an "or" gate for error signals. CR7 presents error signals from differential amplifier Q6, while CR6 presents an error signal in the event of either a short circuit or when the Power Supply is driven into the current limiting mode of operation.

When operating in the current limiting mode, differential amplifiers Q2 and Q3 become balanced, thereby causing CR6 to conduct and in turn, drive error amplifier Q5 toward cut-off.

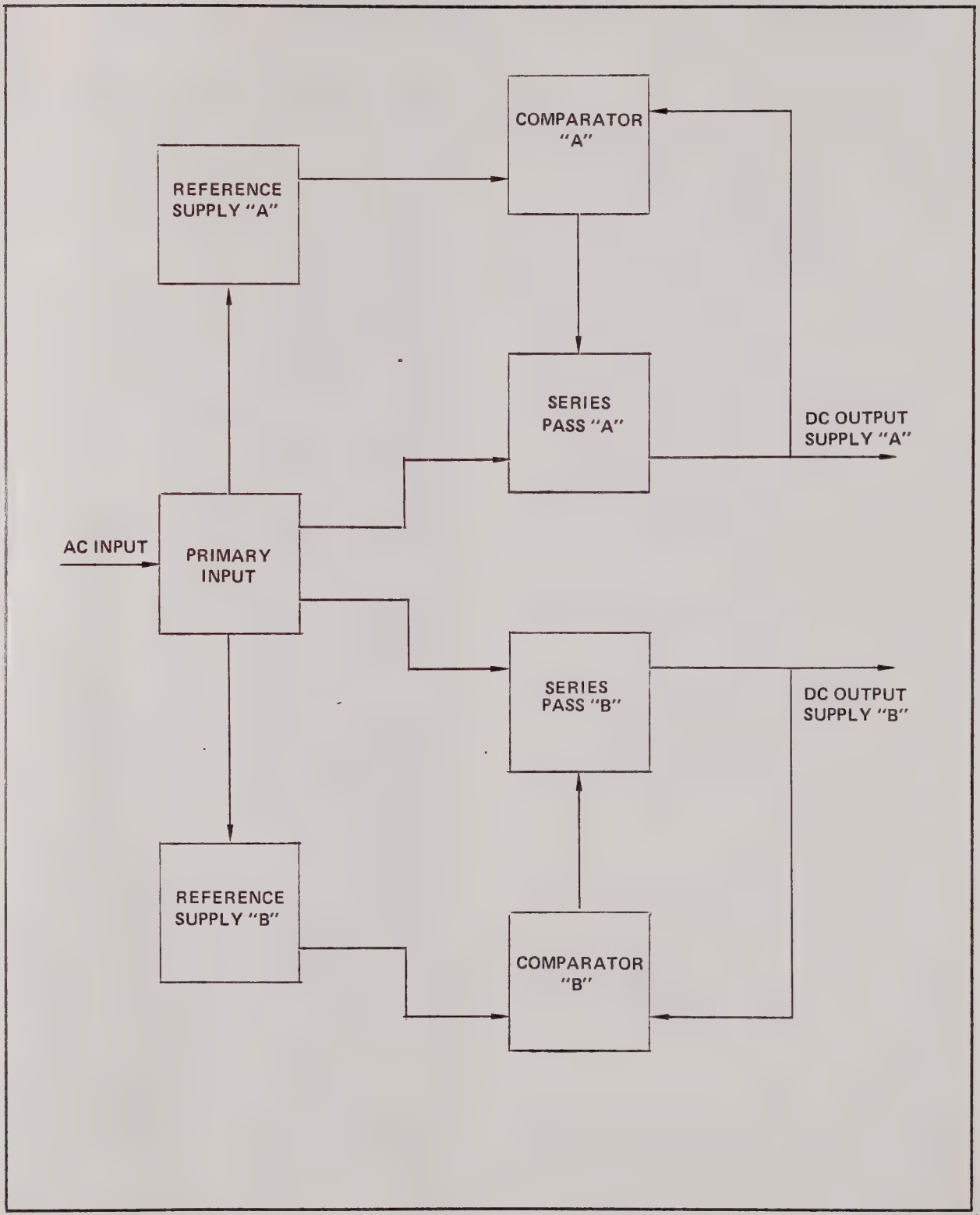


FIGURE 3-1 BLOCK DIAGRAM

CHAPTER 4
MAINTENANCE

4.1 GENERAL

This Power Supply is a precision instrument. It is strongly recommended that only experienced troubleshooting personnel perform troubleshooting operations or attempt to repair the unit. If the Power Supply appears to be malfunctioning at all, the following procedure is recommended for isolating possible defects.

4.2 LOADS AND INTERCONNECTIONS

1. Disconnect all interconnections and loads to which the unit is normally connected.

2. Place shorting links between all appropriate Rear Panel barrier strip terminals. These connections must be securely made, or deterioration of output regulation will occur.

3. Connect a resistive dummy load across output terminals. This load should be of sufficient value to allow the unit to operate at its maximum rated current and voltage output.

4. Apply moninal AC input power to the unit and check for normal operation. Satisfactory operation at this time would indicate that any malfunction previously encountered, is external in nature. All interconnections and loads normally used in conjunction with this Power Supply should then be carefully checked for electrical defects.

4.3 TROUBLESHOOTING

1. Set Front Panel voltage control and current limit control fully CW. Using a digital voltmeter or Oscilloscope, check the voltages across the various circuit components listed on the Schematic Diagram at the rear of this instruction manual. The sample voltages listed apply only if the unit is operating at its nominal AC input, and has a dummy load of sufficient size connected across its output to allow operation at maximum rated current and voltage output levels. Any reading which is grossly incorrect indicates that the stage being tested or the one immediately preceding it is defective. The Block Diagram, Schematic Diagram and appropriate sections of the Theory of Operation will prove helpful in any troubleshooting work. Proper polarity to be observed when testing can be easily ob obtained from the Schematic Diagram.

2. If voltage checks show no noticeable deviations from the prescribed values, disconnect AC power and proceed with point-to-point resistance checks across potentiometers, switches, diodes, resistors, transistors, in that order.

3. When the trouble is of an intermittent nature such as a poor regulation, ripple, etc,, the use of an Oscilloscope to determine dynamic changes will be necessary. The section on Theory of Operation should be consulted to determine circuit performance with varying output conditions.

CHAPTER 5

CALIBRATION

5.1 GENERAL

The following adjustments should be made when necessary to assure optimum operating characteristics and maximum efficiency of the Power Supply.

5.2 TEST EQUIPMENT REQUIRED (Or Equivalent)

1. Oscilloscope, Tektronix Type 561.
2. Differential Amplifier Plug-In, Tektronix Type 63.
3. Digital Multimeter, Systron-Donner 7004A.
4. Time Base Plug-In, Tektronix Type 67.
5. AC VTVM, Hewlett Packard Model 400D.
6. Variable Auto Transformer, Powerstat Type 3PN 136 (5 Ampere rating)

5.2.1 Shorting Link Application

For test purposes, shorting links should be connected across barrier strip terminals to provide local sensing and local voltage programming. To reduce pickup, shielded wire must be used for all connections between test equipment & the Power Supply being tested. To prevent ground loops, it is important that only one ground connection be made, as shown in Figure 5-1. Tighten all terminal connections as securely as possible, and set all Front Panel controls fully CW.

5.3 CALIBRATION PROCEDURE

5.3.1 Voltage Adjust Control

1. Maximum Voltage - Set Front Panel voltage adjust control fully CW. Adjust Maximum Voltage control R20 to obtain an output voltage in excess of the rated output.

2. Minimum Voltage - Set Front Panel Voltage adjust controls fully CCW. Adjust minimum voltage control R24 to obtain a negative output voltage of 0.1 VDC.

3. Adjustment Control - Connect an external test ammeter of appropriate current handling capacity in series with a suitable load.

Set Front Panel Meter Select switch S3 to its current monitoring position. Operate the unit at its rated output as indicated on the external test ammeter, and adjust Ammeter Adjustment control R39 until Front Panel Meter M1 indicates a reading of the same value as that indicated by the external test ammeter.

5.3.2 Constant Voltage Operation

1. Load Regulation - With the equipment connected as shown in Figure 5-1, connect a suitable load resistance across the output terminal connections. The load resistance selected must be able to dissipate the rated power of the unit (P = IE) and must be of sufficient value to yield the rated output current when the rated voltage is applied. Note the voltage indicated on the DVM. Disconnect the resistive load from the output. The maximum change in output DC voltage indicated on the DVM should not exceed by moire than 0.01% or 3 mV (whichever is greater) that of the output voltage indicated with the load resistance applied.

2. LIne Regulation - Place the resistive load across the output and note the voltage indicated on the DVM. Vary the AC input power 10% above and below the nominal AC input level. The maximum change in output voltage should not exceed by more than 0.01% or 1 mV (whichever is greater) that of the output voltage measured at either extreme of the AC input.

3. Ripple Voltage - In order to reduce pickup, shielded test leads should be used in making ripple measurements. With the resistive load connected across the output terminals, measure the AC cipple with the AC VTVM. Vary the AC input level. The maximum ripple amplitude should not exceed 250 μV RMS.

5.3.3 Current Limiting

With the equipment turned off, connect a variable resistive load across output terminals. Set Front Panel Meter switch S3 to its voltage V position. S Set the variable load resistor to its maximum resistance setting, and then slowly decrease the resistance until a decrease in the voltage indication on the Front Panel Meter M1 occurs. Observe that as the resistance value continues to decrease, the indicated output voltage also decreases. Set Front Panel Meter switch S3 to its current (I) position, and note the current indication. Current limiting is effective at the indicated levels. Similar procedure should be followed for Output A section.

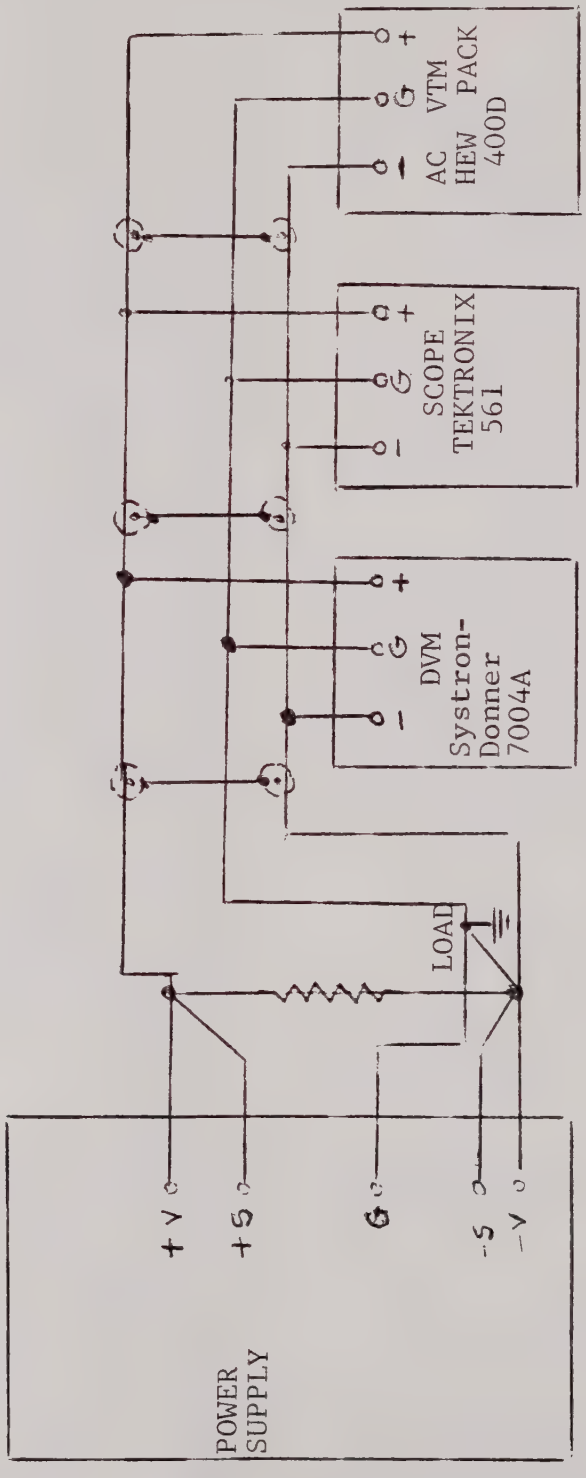


FIGURE 5-1 CONSTANT VOLTAGE OPERATION

CHAPTER 6

REPLACEABLE PARTS

6.1 INTRODUCTION

This chapter contains the spare parts lists for the Model DL40-1A Dual Output Power Supply. Ordering information is included and should be used when purchasing parts from the factory. Explanation of the column listings and Table 6-1 Manufacturers Code-To-Name Index are also included.

6.2 PART ORDERING INFORMATION

To order a part from the Replaceable Parts List, state the Systron-Donner part number, indicate the quantity required and address the order to the nearest Systron-Donner Sales or Service Center.

To order a part not listed in the Replaceable Parts List, state the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Systron-Donner Sales or Service Center.

6.3 PARTS LISTS

Table 6-1 gives the Code-To-Name information for the manufacturers listed in the replaceable parts lists. The replaceable parts lists are placed in a numbered sequence.

Each column in the parts lists provide specific information relating to the listed parts as follows:

(1) DESIGNATOR: Reference numbers applicable to assemblies are listed in alpha-numeric order.

(2) COMPONENT NOMENCLATURE AND DESCRIPTION: Component names and specifications are provided in these columns and include; value, tolerance, wattage rating, working voltage, construction, etc.

(3) MANUFACTURER'S CODE: H4-2 Federal Supply Code numbers are listed to identify component manufacturers. A Manufacturers Index is provided in this Chapter for cross-reference.

(4) MANUFACTURER'S PART NUMBER: True manufacturer part numbers are listed in this column.

(5) SD STOCK NUMBER: The Systron-Donner stock number is listed in this column.

(6) T/Q (Total Quantity): This quantity, appearing after an item entry, indicates the number of times the component is used in that assembly. The total quantity for each part is given only once - at the first appearance of the part number in the list.

TABLE 6-1 MANUFACTURER'S CODE-TO-NAME INDEX

CODE	NAME & ADDRESS
00853	Sangamo Electric Co. So. Carolina Division P.O. Box 128 Pickens, S.C. 29671
01121	Allen Bradley Co. 1201 S. 2nd St. Milwaukee, WI 53204
02660	Amphenol Corp. 2801 So. 25th Ave. Broadview, IL 60153
02735	RCA Corp. Solid State Div. Route 202, Somerville, NJ 08876
03877	Transitron Electronic Corp. 168-186 Albion St. Wakefield, MA 01880
04713	Motorola Semiconductor Prod Div. 5005 East McDowell Rd. Phoenix, AZ 85008
05820	Wakefield Engineering Inc. Audubon Rd., Wakefield, MA Wakefiled, MA 01880
06383	Panduit Corp. 17301 Ridgeland Tinley Park, IL 60477
07088	Kalvin Electric Co. 5907 Noble Ave. Van Nuys, CA 91401
07263	Fairchild Camera & Instrument Corp. Semiconductor Div. 313 Frontage Rd. Mountain View, CA 94040
11236	CTS of Berne Inc. 406 Parr Rd. Berne, IN 46711
12697	Clarostat Mfg. Co. Inc. Lower Washington St. Dover, NH 03820
14604	Elmwood Sensors Inc. 1655 Elmwood Ave. Cranston, RI 02907
15915	Tepro of Florida Inc. 2608 Enterprise Rd. Dunedin, FL 33528
52542	Systron-Donner Corp. Instrument Division 10 Systron Dr. Concord,CA 94518
58474	Superior Electric Co. 383 Middle St. Bristol, CT 06010
71590	Globe-Union Inc. Centralab Electronics Div. 5757 No. Green Bay Ave. Malwaukee, WI 53201
72982	Erie Technological Products 644 W. 13th St. Eris, PA 16512
73138	Beckman Instruments Inc. Helipot Division 2500 Harbor Blvd. Fullerton, CA 92634
75915	Littlefuse Inc. 800 E. Northwest Hwy. Des Plaines, IL 60016
81349	MIL STD
83777	E-Systems Inc. Memcor Division 41 E. park Dr. Huntington, IN 46750

REPLACEABLE PARTS LIST

TITLE: MODEL DL40-1A SHIPPING ASSEMBLY T18200 Rev D

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
		ASSEMBLY, Case	52542	PD25571	PD25571	1
		HANDLE	12136	919-414-173	PD920050	1
		STAND, Adj	21604	MP40008-1	100917	1
		STRIP, Insulator	76381	4116	119674	1
		STRIP, Rubber	52542	T950174	T950174	A/R
		CASE	52542	T111434	T111434	1
		RIVET, Pop	61957	AD42-A-BS-1/8	T960345	8
		FEET, Rubber	76493	2096W	840192	4
		CHASSIS ASSEMBLY	**52542**	**PD25564**	**PD25564**	**1**
	C114	CAPACITOR, Mylar .1 μF 600V, 20%	99515	D6-104	100158	2
	C115	Same as C114				
	F101	FUSE, SB 2-1/2A	75915	31302.5	870175	1
	T1	TRANSFORMER	52542	504304	504304	1
		LABLE, Fuse 2-1/2A SB	52542	780639	780639	1
		LABLE, Input 115 VAC	52542	06509602	06509602	1
		HOLDER, Fuse	75915	345001	117377	1
		CORD, Line	70903	BR-1736	102407	1
		CONNECTOR, AC	82389	EAC-301	101288	1
		SPACER, Hex	06540	9738-SS-0632-0	860013	6
		STANDOFF, 6-32	17117	3023-91-1	860070	1
		SPACER, Round	06540	9224-B-140-4	860296	4
		CHASSIS	52542	065019	065019	1
		NUT, Speed #6	78553	C7852-632-24	981041	8
		NUT, Speed #8	78553	C9807-832-4	981043	2
		HEATSINK ASSEMBLY	**52542**	**PD26652**	**PD26652**	**1**
	Q201	TRANSISTOR	04713	2N3233	705070	4
	Q202	Same as Q201				
	Q203	Same as Q201				
	Q204	Same as Q201				
	R201	RESISTOR, WW 1.0 Ω 3%, 3W	15915	TS2D	630030	2
	R202	Same as R201				
	R203	RESISTOR, CC 220 Ω 5%, 1/2W	01121	EB2215	101667	2
	R204	Same as R203				
	S201	SWTICH, Thermal	14604	2450-88-16	880007	1
		SOCKET, Transistor	88625	4601	830101	4
		WASHER, Mica	08289	DM-01	T990290	4
		HEATSINK	52542	119142	119142	1

TITLE MODEL DL40-1A SHIPPING ASSEMBLY T18200 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
		HARNESS, Cable	52542	PD2555601	PD2555601	1
		LUG, #6	Peter de Laet	R490620VF	T960558	2
		METER BD/FP ASSEMBLY	**52542**	**PD25560**	**PD25560**	**1**
	DS101	LITE, Pilot	91802	2110A(Red)	770024	1
	M1	METER	52542	753315	753315	2
	M101	Same as M1				
	S202	SWITCH, ON-OFF	52542	880015	880015	2
		EXTENDER, Shaft	83330	160	840110	2
		SPACER, Hex	06540	9740-SS-0632-7	860014	6
		KNOB, W/Line	86797	RB-67-1-M-9	T920072	2
		KNOB, Plain	86797	RB-67-1-M	T920073	2
		POST, Binding Black	58474	DF21BC	102647	2
		POST, Binding Red	58474	DF21RC	102646	2
		POST, Binding White	58474	DF21WTC	102648	2
		PANEL, Front	52542	119644	119644	1
		WASHER	44655	6001	T980120	1
		METER PC ASSEMBLY	**52542**	**PD25559**	**PD25559**	**1**
	C8	CAPACITOR, El Ax 1100 μF +75-10%, 50V	56289	39D118G050HP	100227	2
	C108	Same as C8				
	R34	RESISTOR, Variable 100 Ω 10%, 2W	52542	600044	600044	2
	R42	RESISTOR, Variable 20 k	73138	7216R20K	600374	2
	R134	Same as R34				
	R142	Same as R42				
	S3	SWITCH, Slide	82389	99-016-1203BLK	880615	2
	S103	Same as S3				
		EYELET	57771	A2059	T960660	24
		EYELET	57771	A1798	T960670	12
		EYELET	57771	A2085	T960663	13
		CABLE, Inter-Connect		24-010-103	116563	1
		BOARD, PC	52542	065617	065617	1
		COMPONENT PC ASSEMBLY	**52542**	**PD25555**	**PD25555**	**1**
	C1	CAPACITOR, El Ax 500 μF -10+100%, 75V	56289	39D507G075HL4	810223	2
	C2	CAPACITOR, Ceramic .01 μF 20%, 500V	91418	TYPE SM	100075	4
	C3	Same as C2				

TITLE MODEL DL40-1A SHIPPING ASSEMBLY T18200 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C4	CAPACITOR, Ceramic .001 μF 20%, 200V	91418	TYPE B	100076	2
	C5	CAPACITOR, Ceramic .0047 μF 10%, 600V	71590	CE-472	800050	2
	C6	CAPACITOR, El Ax 800 μF 10%, 50V	56289	39D807G050HL4	810226	2
	C9	CAPACITOR, Film Polyester 1.0 μF 10%, 250V	52763	MKT1813-510/25	800304	2
	C10	CAPACITOR, MF 34 μF 15V	56289	30D50G050DD9	810057	2
	C11	CAPACITOR, El Ax 68 μF 20%, 6V	56289	196D686X0006	821019	4
	C12	CAPACITOR, El Ax 850 μF 75V	56289	39D857G075HS4	810230	2
	C13	Same as C11				
	C101	Same as C1				
	C102	Same as C2				
	C103	Same as C2				
	C104	Same as C4				
	C105	Same as C5				
	C106	Same as C6				
	C109	Same as C9				
	C110	Same as C10				
	C111	Same as C11				
	C112	Same as C12				
	C113	Same as C11				
	CR3	DIODE, Zener 24V	03877	1N4749A	720155	2
	CR4	DIODE, Zener 15V	04713	1N5352B	720150	2
	CR5	DIODE, Ref 9.4V	03877	1N2163A	720262	2
	CR14	DIODE, Zener 5.1V	03877	1N751A	100378	2
	CR18	DIODE, Zener 5.6V	03877	1N752A	100376	2
	CR103	Same as C3				
	CR104	Same as C4				
	CR105	Same as C5				

TITLE MODEL DL40-1A SHIPPING ASSEMBLY T18200 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	CR114	Same as CR14				
	CR118	Same as C18				
	R1	RESISTOR, WW 250 Ω 5%, 5W	75042	BWH	640402	2
	R2	RESISTOR, MF 1.5 k 1%, 1/2W	81349	RN65D1501F	620360	2
	R3	RESISTOR, MF 402 Ω 1%, 1/2W	81349	RN65D4020F	620140	2
	R4	RESISTOR, MF 9.76 Ω 1%, 1/2W	81349	RN65D9761F	620599	4
	R5	Same as R4				
	R6	RESISTOR, CC 680 Ω 5%, 1/2W	01121	EB6815	101475	2
	R7	RESISTOR, MF 2.49 Ω 1%, 1/2W	91637	MFF 1/4 T1	102196	2
	R8	RESISTOR, MF 6.81 k 1%, 1/2W	81349	RN65D6811F	620596	2
	R9	RESISTOR, MF 475 Ω 1%, 1/2W	81349	RN65D4750F	620160	2
	R10	RESISTOR, MF 6.19 k 1%, 1/2W	81349	RN65D190F	620592	2
	R11	RESISTOR' CC 1 k 5%, 1/2W	01121	EB1025	101467	8
	R12	RESISTOR, CC 33 k 5%, 1/2W	01121	EB3335	101456	2
	R13	RESISTOR, MF 75 k 1%, 1/2W	81349	RN65D7500F	620754	2
	R14	RESISTOR, MF 12.7 k 1%, 1/2W	81349	RN65D1272F	620621	2
	R15	RESISTOR, MF 6.34 k 1%, 1/2W	81349	RN65D431F	620591	2
	R16	RESISTOR, MF 6.65 k 1%, 1/2W	81349	RN65D6651F	620593	4
	R17	Same as R16				
	R19	RESISTOR, MF 2.55 k 1%, 1/2W	81349	RN65D2551F	620462	2
	R20	RESISTOR, Variable 1 k 5%, 1/2W	73138	72PR1K	600156	4

TITLE MODEL DL40-1A SHIPPING ASSEMBLY T18200 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R23	RESISTOR, WW 500 Ω 3%, 3W	56289	1300S500-3	630340	2
	R24	Same as R20				
	R25	RESISTOR, WW 4 k 5%, 5W	94655	995-5B	640549	2
	R26	RESISTOR, WW 1 k 3%, 3W	15915	TS2D	630390	2
	R27	Same as R11				
	R28	Same as R11				
	R29	Same as R11				
	R30	RESISTOR, CC 3.3 k 5%, 1/2W	01121	EB3325	101432	2
	R31	RESISTOR, WW 2.5 k 5%, 10W	12697	VC10F	640543	2
	R36	RESISTOR, MF 1.0 Ω 3%, 3W	15915	TS2D	630030	2
	R38	RESISTOR, WW 560 Ω 10%, 2W	75042	BWH	640480	2
	R39	RESISTOR, Variable 100 Ω 10%, 1/2W	73138	72PR100	117188	4
	R40	RESISTOR, WW .1 Ω 3%, 5W	15915	TSK5 .1 3%	117465	2
	R41	RESISTOR, MF 39.95 k 1%, 1/2W	81349	RN65D3995F	620700	2
	R44	RESISTOR, CC 470 Ω 5%, 1/2W	01121	EB4715	101539	2
	R46	RESISTOR, MF 340 Ω 1%, 1/2W	81349	RN65D3400F	620130	2
	R47	Same as R39				
	R101	Same as R1				
	R102	Same as R2				
	R103	Same as R3				
	R104	Same as R4				
	R105	Same as R4				
	R106	Same as R6				
	R107	Same as R7				
	R108	Same as R8				

TITLE MODEL DL40-1A SHIPPING ASSEMBLY T18200 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R109	Same as R9				
	R110	Same as R10				
	R111	Same as R11				
	R112	Same as R12				
	R113	Same as R13				
	R114	Same as R14				
	R115	Same as R15				
	R116	Same as R16				
	R117	Same as R16				
	R119	Same as R19				
	R120	Same as R20				
	R123	Same as R23				
	R124	Same as R20				
	R125	Same as R25				
	R126	Same as R26				
	R127	Same as R11				
	R128	Same as R11				
	R129	Same as R11				
	R130	Same as R30				
	R131	Same as R31				
	R136	Same as R36				
	R138	Same as R38				
	R139	Same as R39				
	R140	Same as R40				
	R141	Same as R41				
	R144	Same as R44				
	R146	Same as R46				
	R147	Same as R39				
	TB1	STRIP, Barrier	52542	T111376	T111376	1
		TRANSISTOR	02735	2N4238	700047	2
		TRANSISTOR	02735	2N2714	700180	14
		TRANSISTOR	02735	2N2905A	705067	2

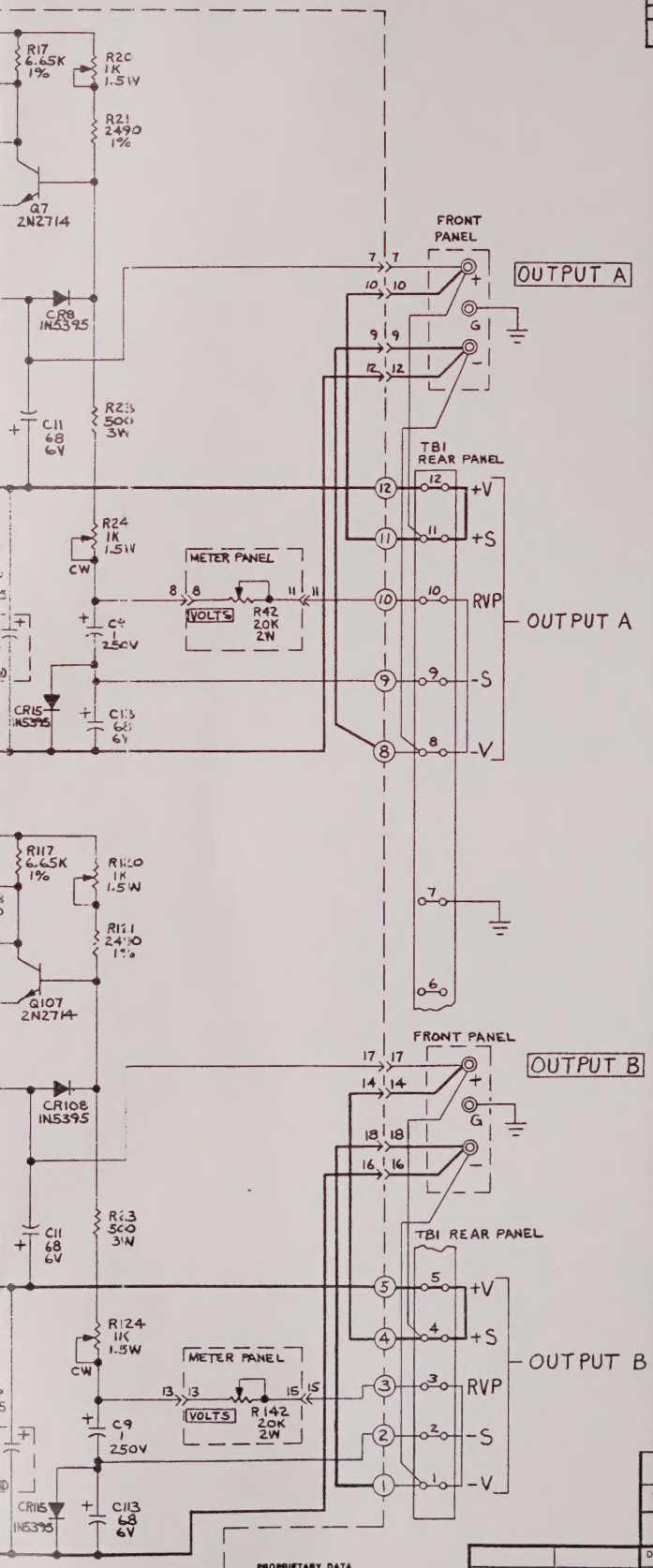
REPLACEABLE PARTS LIST

TITLE MODEL DL40-1A SHIPPING ASSEMBLY T18200 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
		LINK	75382	600J	840217	6
		PAD, Transistor Small	07047	10194-DAP	840411	14
		PAD, Transistor Large	07047	10079-DAP	840420	4
		TIE, Wrap	06383	SSTI	T101115	6
		BRACKET, Barrier	52542	T111392	T111392	1
		TERMINAL	88625	1540-2	T960464	40
		TERMINAL	98278	001-0091-003	543131	22
		SOCKET, IC 24-pin	73803	C84-24-02	103845	1
		BOARD, PC				

T1
504304
S201
135
DS101
AC
S202
FRONT PANEL
P.C. BOARD
119906
F101
CR1 IN5395
CR2 IN5395
R1 250 2W
C1 500. 75V
4.4V
R2 1.5K 1%
2N2714 Q1
R3 402 1%
CR4 720150 15V
CR3 720155 2.4V
CR5 IN2163A 9.4V
14.4V
R4 9.76K
R5 9.76K
R6 680
C2 .01 600V
Q2 2N2714
Q3 2N2714
R37 2.49K 1%
R7 2490 1%
R9 475 1%
Q4 2N2714
CR6 IN5395
C3 .01
Q5 2N3638
R11 1K
R10 6.19K 1%
R12 33K
C4 .001
R8 6.81K 1%
R14 12.7K 1%
9.4V
R16 6.65K 1%
C5 .0047
R15 6.34K 1%
Q6 2N2714
R13 75K 1%
CR7 IN539
R144 470
CR17 IN5395
CR20 IN5395
Q201 705070
Q202 705070
R201 1 3W
R203 220
HEATSINK
CR10 CR12 CR11 CR13 IN5395 (4 PLCS)
R26 1 3W
Q9 2N4238
R29 1K
R30 33K
R27 1K
Q10 2N714
R28 1K
R31 2.5K 10W
30V
C6 800 50V
C12 850 75V
58V
R25 4K 5W
C115 .1 600V
R36 1 3W
METER PANEL
AMPS
R34 100
CW
R47 200
R46 340 1%
CR18 IN752A 5.6V
CR14 IN751A 5.1V
C10 34 15V
R38 560 2W
R39 100 .5W
R40 .1Ω-5W
SHUNT
R41 39.95K
FRONT PANEL
M1
VA
S3 METER SW.
CR101 IN5395
CR102 IN5395
R101 250 5W
C101 500 75V
Q101 2N714
R102 1.5K 1%
R103 402 1%
CR104 720150 15V
CR103 720155 2.4V
CR5 IN2163A 9.4V
R104 9.76K
R105 9.76K
R106 680
C102 .01 600V
Q102 2N714
Q103 2N714
R137 2.49K 1%
R107 2490 1%
R109 475 1%
Q104 2N714
CR106 IN5395
C103 .01
R110 6.19K 1%
R111 1K
R112 33K
C104 .001
R108 6.81K 1%
R114 12.7K 1%
9.4V
R116 6.65K 1%
C105 .0047
R115 6.34K 1%
Q106 2N714
R113 75K 1%
R144 470
CR110 CR112 CR111 CR113 IN5395 (4 PLCS)
CR117 IN5395
CR120 IN5395
Q203 705070
Q204 705070
R202 1 3W
R204 220
HEATSINK
R126 1K 3W
R127 1K
Q109 2N4238
R129 1K
R130 3.3K
Q110 2N714
R128 1K
R131 2.5K 10W
30V
C106 800 50V
C112 850 75V
58V
R125 4K 5W
C114 .1 600V
R136 1 3W
METER PANEL
AMPS
R134 100
CW
R147 200
R146 340 1%
CR118 IN752A 5.6V
CR114 IN751A 5.1V
C110 34 15V
R138 560 2W
R139 100 .5W
R140 .1Ω-5W
SHUNT
R141 39.95K
FRONT PANEL
M101
VA
S103 METER SW

REVISIONS					
REV	DESCRIPTION	SRL NO.	ECO NO.	DATE	APP. BY
K	REDRAWN FROM 'E' SIZE			2/81	



PRIMARY VOLTAGES	TRANSFORMER CONNECTIONS JUMPER	A.C. CORD TO	F.101 FUSE
100	1-15, 2-17	16	2.5A S.B.
115/120	1-15, 2-17	17	2.5A S.B.
208/220	15-2	16	1.5A S.B.
230/240	15-2	17	1.5A S.B.

NOTES:

1) UNLESS OTHERWISE NOTED:
   RESISTORS ARE IN OHMS, ½W, 10%
   CAPACITORS ARE IN MICROFARADS
2) * DENOTES SELECT AT TEST
3) TRANSFORMER SHOWN STRAPPED FOR 115/120 VOLT OPERATION. FOR OTHER PRIMARY VOLTAGES SEE CHART
4) ○ - CONTROL BOARD CONNECTIONS
   □ - METER BOARD CONNECTIONS

ITEM NO.	QTY	PART NUMBER	DESCRIPTION	SCHEMATIC REF. NO.

LIST OF MATERIALS

PROPRIETARY DATA

Furnished under United States Government Contract No. _____
Shall not be either released outside the Government, or used, duplicated, or disclosed in whole or in part for manufacture or procurement, without the written permission of Systron-Donner Corporation except for: (1) emergency repair or overhaul work by or for the Government, where the item or process concerned is not otherwise reasonably available to enable timely performance of the work; or (2) release to a foreign government, as the interests of the United States may require; provided that in either case the release, use, duplication or disclosure hereof shall be subject to the foregoing limitations. This legend shall be marked on any reproduction hereof in whole or in part.

DRAWN	B 2/81	DATE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMAL TOLERANCE .X ±, .XX ±, .XXX ±, ANGLES ±
CHECK		DATE	
ELECT.		DATE	
MECH.		DATE	
PROJECT		DATE	
QA		DATE	
SCALE		DO NOT SCALE DRAWING	SH 1 OF 1
MATERIAL			

SYSTRON DONNER CORPORATION
CONCORD, CALIFORNIA
CODE IDENT. 52542

SCHEMATIC

DRAWING NO.			
REF	SIZE	PART NO.	REV
	D	120120	K

DL40-1A	
USED ON	NEXT ASSY
APPLICATION	

120120

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